Curator, Metafor and CMIP5, GO-ESSP, ESG, . . .

GISS AR5 Workshop
New York, NY

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Talk outline. . .

1. CMIP-5 timeline
   - Querying model characteristics
2. Curator and Metafor
   - Search
   - Gridspec
   - Analysis and Visualization
3. What we might be able to do for CMIP5

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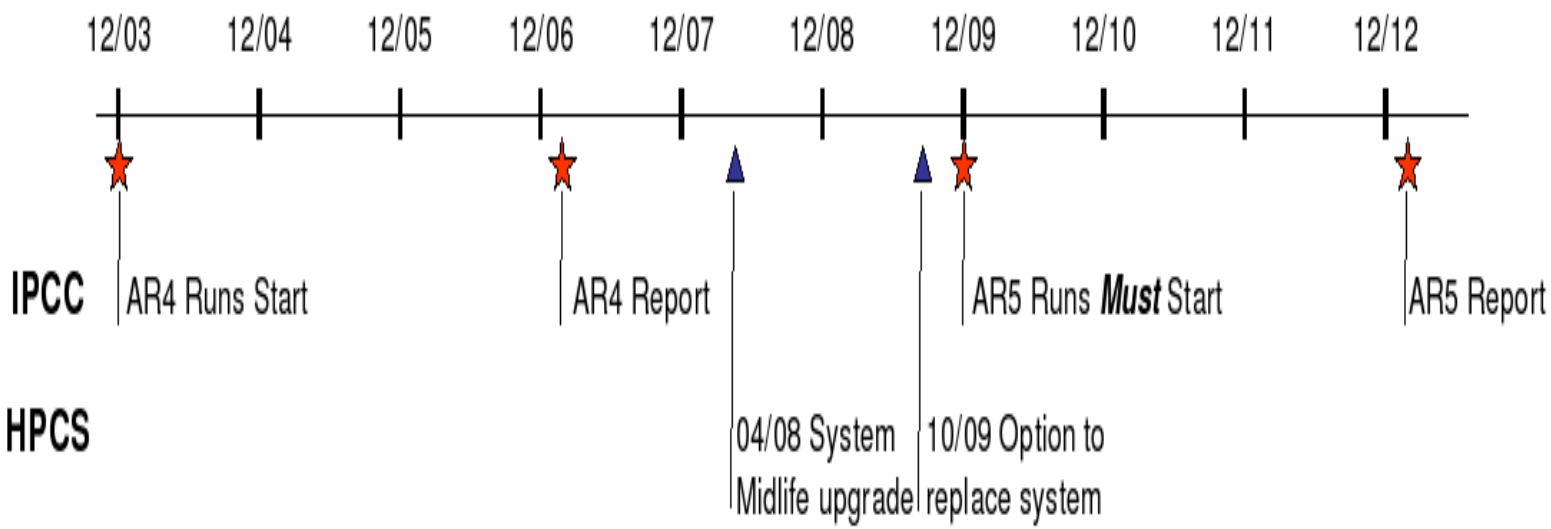
CMIP-5 timeline



- CMIP-5 more complicated than CMIP3 (AR4).
- CMIP-5 experiments will have links with other MIPs, principally PMIP and CFMIP, with their own timelines. Also CCMVal.
- A lot of people who participate in these projects also do ENSEMBLES (already begun. . .) may be a useful test case.
- CMOR-2 delivered for alpha-test in Oct 2008; beta-test in December 2008.

Points from GO-ESSP and WGCM meetings

- GO-ESSP meeting (Seattle, 17-19 September 2008) discussed a federation of geographically distributed data portals to maintain common conformant metadata for CMIP5.
- WGCM meeting (Paris 22-24 September 2008) developed consensus on the set of experiments for CMIP5/AR5. Includes “traditional” CMIP experiments; also includes a set of initialized runs for “decadal prediction” (think: ensembles, initial condition datasets. . .); carbon cycle experiments (new metadata); more detection and attribution runs (require description of forcings).
- discussion of filenaming conventions: activity, institute, model, scenario/experiment, realm, data frequency, variable name, local ensemble member, version
- broad acceptance of native grids (ocean group insists. . .)
- broad acceptance of need for structured info to replace AR4 questionnaire (SurveyMonkey looks great!)
- Controlled vocabulary for keys/values?

Can the database answer these questions?

- What's the difference between the NASA GISS-EH and GISS-ER models?
- Which runs from the GFDL CM2.1 model would I compare to isolate the effects of volcanoes on 20th century climate?
- Do volcano runs from GFDL CM2.1 and CCSM use the same forcing dataset?
- Which runs in the database include the indirect effect of aerosols?
- Retrieve "high cloud amount" from multiple models. (Not uniquely specified by standard name `cloud_amount_in_atmospheric_layer`!)

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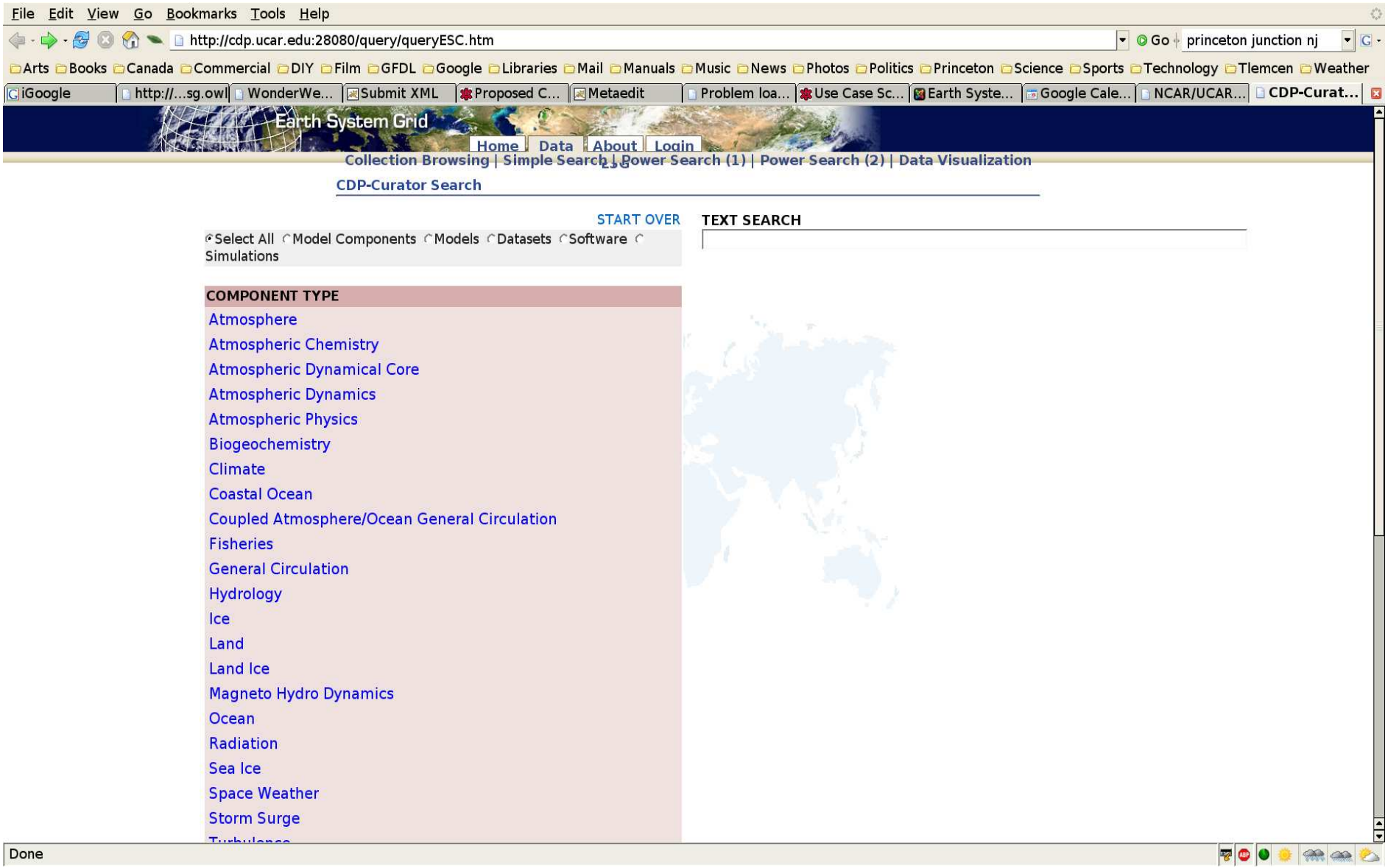
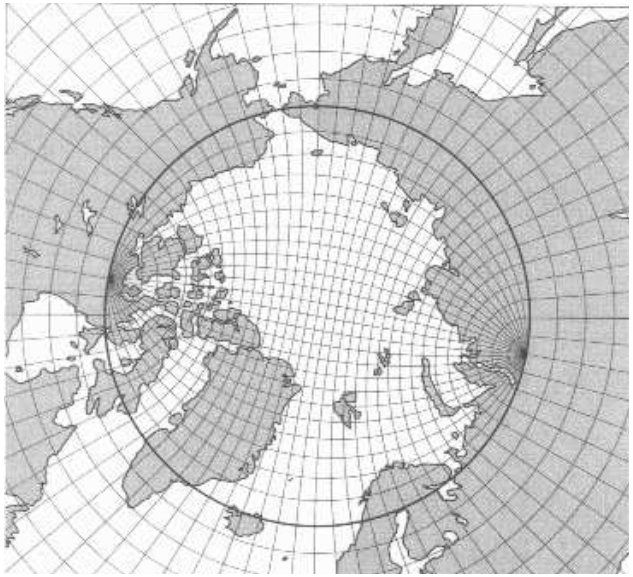
ESG, Curator (ESC) and Metafor

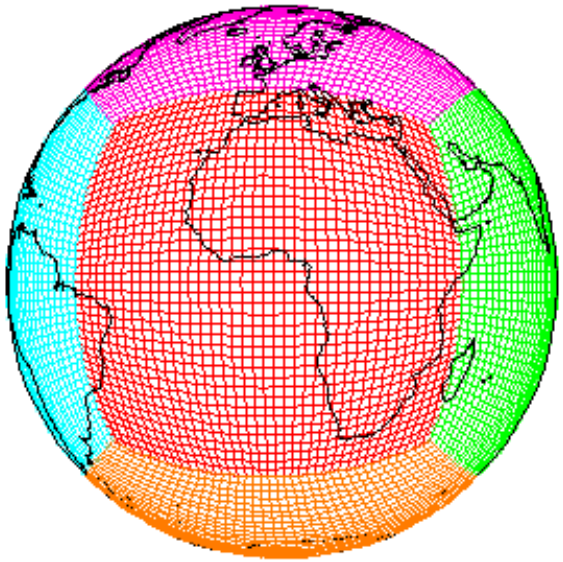
- Earth System Grid (ESG) is tasked with building technology layers needed for linking a federation of geographically distributed data portals for CMIP5.
- Curator (US: 2005-2008) and Metafor (EU: 2008-2011) are proposal-driven projects to organize climate model metadata.
- Curator recognized that all the configuration information associated with a climate model could potentially be captured in the output metadata: the workflow is the metadata.
- Metafor continues this line of thought with a project to build a Common Information Model (CIM) for climate model data.
- All projects seek to work with existing standards (e.g CF) where available.

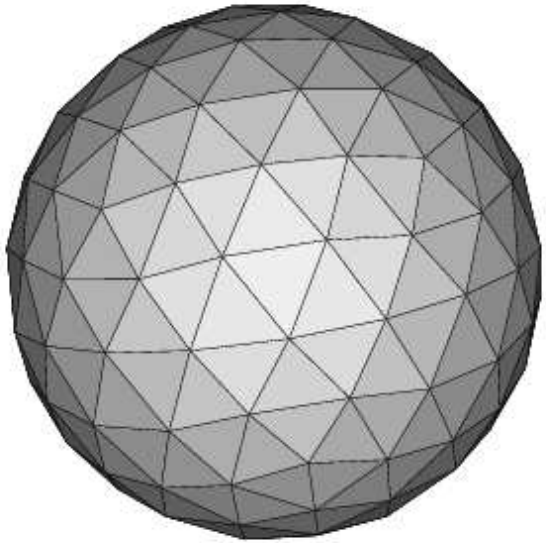
ESG/Curator Faceted Search

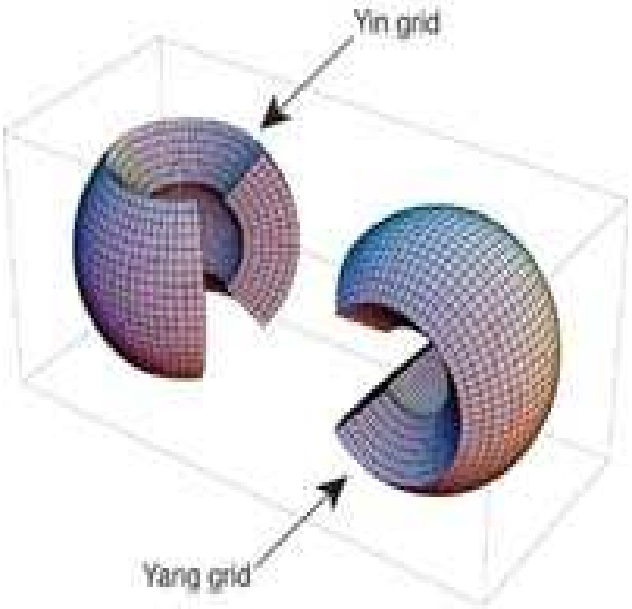


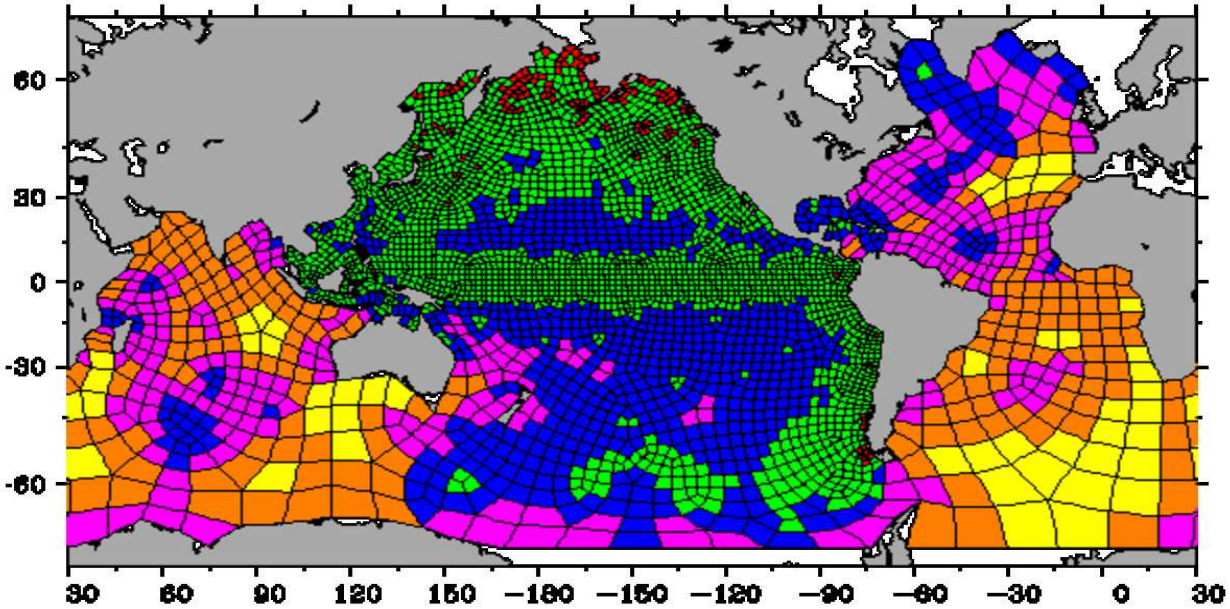
Horizontal grids in use in ESMs



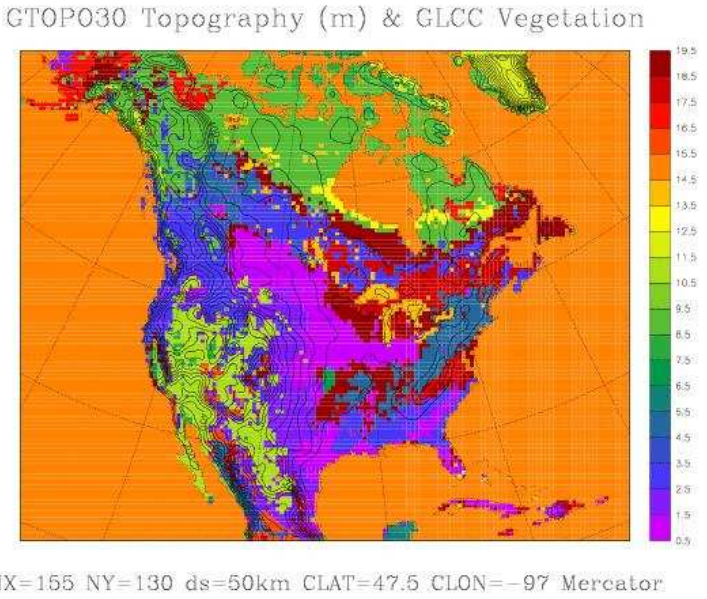


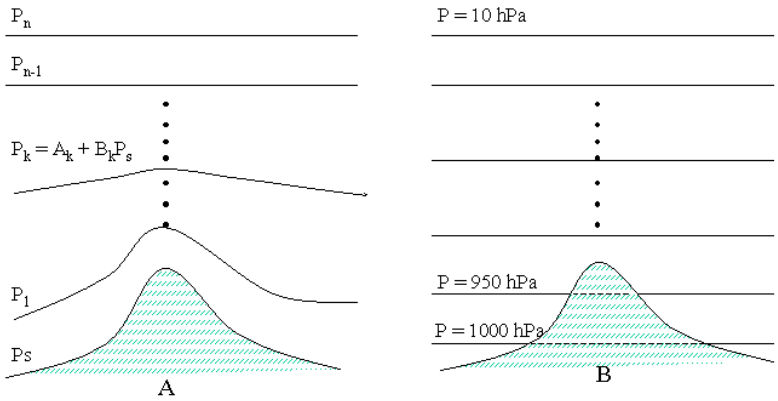






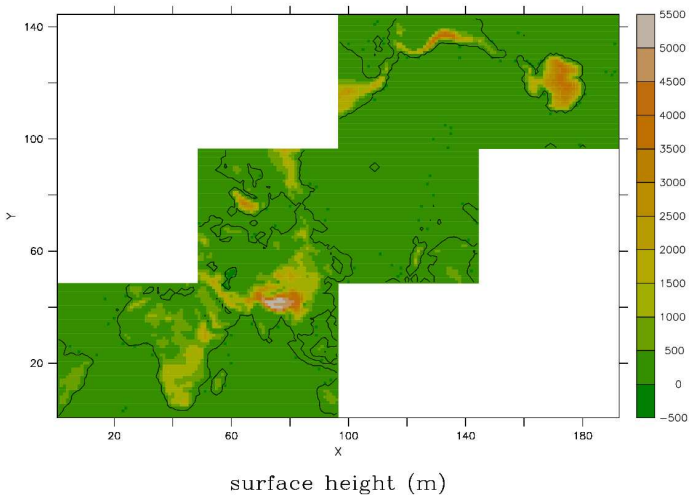
Vertical regridding: NARCCAP

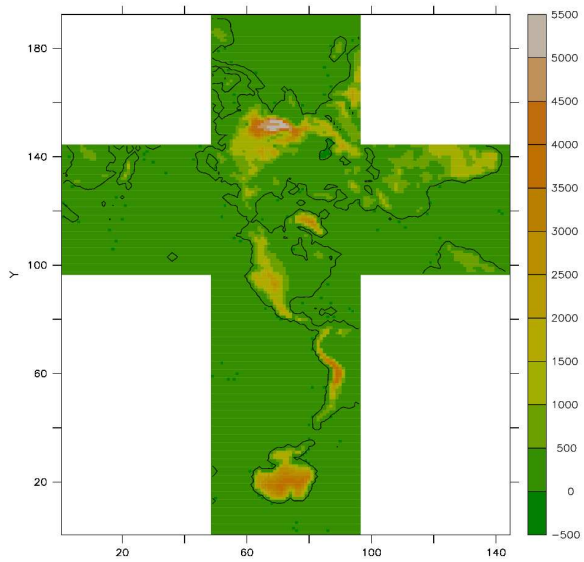




- The NARCCAP experiment is a MIP aimed at the “development of multiple high resolution regional climate scenarios for use in impacts assessments.”
- High-resolution models requires forcing data from global models and analysis in specified resolution, projection, and vertical levels.
- Data volumes are high: GFDL has chosen to supply data on its native grid (24 levels) instead of the required 40; in conjunction with a program for converting data from σ-hybrid to pressure.

Analysis and visualization





- `ferret`, a widely-used analysis and plotting utility is now capable of interpreting gridspec files and displaying the associated mosaic datasets. A “native” capability within `ferret` is being built, including as a “web service”!
  `http://www.gfdl.noaa.gov/~atw/ferret/cubed_sphere/`
- Prototyping complex analyses (e.g “NINO3 SST spectra”) as web services.

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Proposal for a Curator/Metafor product. . .

Small, self-contained, high-impact, within project scope. . .

- Begin with a CMIP5 AppCIM profile based on AR4 model metadata
- Add new fields (grid metadata; forcing fields and other datasets; in conjunction with PCMDI)
- Describe associated software?
- Telco on 10 October to discuss metadata changes for CMIP5 (includes Metafor, ESC, PCMDI, GFDL)
- Need to finalize the “CIM profile” for CMIP5 by December 2008?
- Create SurveyMonkey-based questionnaire from the above
- Release by Jan 2009?

Hypothetical CMIP5 case study

CMIP scientific question: response across a set of diverse models to "gregory-style forcing": response of a model at equilibrium to an abrupt increase in CO2 to 4X.

- model "GFDL CM2.1"
- Scientific contact: Georgeanne at Princeton
- ocean "MOM4" uses tripolar grid, 1-deg in longitude, 1/3-1 deg variable in latitude: "OM3"
- atmos "FVLL" uses lat-lon grid 2x2.5 "M45"

Hypothetical CMIP5 case study (contd. . .)

CMIP scientific question: response across a set of diverse models to "gregory-style forcing": response of a model at equilibrium to an abrupt increase in CO2 to 4X.

- model "GFDL CM2.1"
- simulation 1:
  - forcing dataset (boundary condition): constant CO2 data from 2000, netCDF file interpolated to atm grid, "fvll-m45-co2-200-annual.nc"
  - run to equilibrium: 500 years in 100-year segments
  - save data from year 500 to year 700
  - data variables follow CMOR tables: static data, monthly mean, annual, seasonal, etc.
- simulation 2:
  - forcing dataset "fvll-m45-4Xco2-200-annual.nc"
  - restart model using initial condition from year 560 of simulation 1.
  - run for 200 years, save same data.

Hypothetical CMIP5 case study (contd. . .)

- model "HADCM3"
- Scientific contact: Hadrian at Exeter
- ocean "UM Ocean" uses lat-lon grid at 2x2 "HadOcn3"
- atmos "UM Atm" uses lat-lon grid 2x2.5 "HadAtm3"
- simulation 1:
  - forcing dataset (boundary condition): constant CO2 data from 2000
  - standard dataset processed by pre-processing software "HadPP" run to equilibrium: 1000 years in 20-year segments
  - save data from year 1000 to year 1200
  - data variables follow CMOR tables: static data, monthly mean, annual, seasonal, etc.
- simulation 2:
  - model "HadCM3a", same as HadCM3, but code modified to multiply CO2 inputs by 4.
  - restart model using initial condition from year 1200 of simulation 1. run for 200 years, save same data.

Potential pathways for analyzing multi-model ensembles

- Perform analyses “server-side” and download results. Likely to be restricted palette of analysis options; unlikely you would get to “upload” *your* analysis onto *their* servers.
- Download MME regridded onto target grid of your choice, organized with an ensemble axis (`x,y,z,t,n`).
- Download native grid data *and* associated regridding tools (see NARCCAP example above) and construct common-grid ensemble yourself.